

REMARKS

The specification and drawings have been amended to correct minor errors noted in the Office Action and otherwise.

Claims 1 and 6 have been amended to further particularly point out and distinctly claim subject matter regarded as the invention.

New claim 28 also particularly points out and distinctly claims subject matter regarded as the invention.

The amendments presented are made for the purposes of better defining the invention, rather than to overcome the rejections for patentability. Support for the amendments herein presented can be found in the specification and claims as filed. No new matter has been introduced as a result of the amendments. Reconsideration and allowance is respectfully requested in view of the amendments and the following remarks.

Election With Traverse

A restriction requirement has been imposed by the Examiner. A provisional election was made with traverse to prosecute the invention of claims 1-11 in a telephone conversation with the examiner and Applicants representative on or about January 5, 2002. That provisional election is hereby confirmed.

The 35 U.S.C. § 102 Rejection

Claims 1-5 stand rejected under 35 U.S.C. § 102 as being allegedly anticipated by Herb et al. (U.S. Patent No.5,316,842). This rejection is respectfully traversed.

In the Office Action at paper number 5, paragraph 6, the Office Action asserts that Herb et al. discloses an article comprising diamond deposited on a framework material substrate wherein each of the substrate particles has first surface regions in contact with intermediately adjacent other ones of the particles and second surface regions spaced apart from the immediately adjacent ones of particles. The Office Action asserts that Herb teaches the inter-particle voids are not completely filled with a diamond material at claim 8. The Office Action asserts that such a substrate framework inherently has a porosity sufficient to permit the flow of fluids in at least one direction through the material. The Office Action asserts that Herb discloses the substrate being a stainless steel which can be coated with a layer of a second material. The Office Action further asserts that Herb discloses the diamond having a thickness of 25 microns and that the diamond substantially has no voids. Applicants respectfully disagree with the assertions of the Office Action.

The Herb et al. reference actually discloses an article formed from a plurality of non-diamond particles compatible with diamond deposition preformed into a desired shape that will not allow for the flow of fluids. The Herb et al. reference discloses

materials and articles according the (Herb et al.) invention that are fully dense films, free of voids. (See Herb et al. at column 3, lines 55-56). The Herb et al. reference discloses a diamond material produced that is substantially free from voids. The diamond/non-diamond composite materials may be formed by CVD infusion of diamond into the voids of preforms comprising diamond/non-diamond particulate mixtures. (See Herb et al. at column 7, lines 49-67). The Herb et al. reference discloses that the infiltrated diamond component of these composite materials will exhibit substantially no voids. (See Herb et al. at column 9, lines 5-7). The Herb et al. reference discloses that the inter-particle voids are substantially completely filled with said infiltrated high thermal conductivity diamond material. (See Herb et al. at Claim 8, and FIGS. 7 and 8b-e).

To anticipate a claim under 35 U.S.C. § 102, a single source must contain all of the elements of the claim. *Lewmar Marine Inc. v. Barient, Inc.*, 827 F.2d 744, 747, 3 U.S.P.Q.2d 1766, 1768 (Fed. Cir. 1987), cert. denied, 484 U.S. 1007 (1988). Moreover, the single source must disclose all of the claimed elements “arranged as in the claim.” *Structural Rubber Prods. Co. v. Park Rubber Co.*, 749 F.2d 707, 716, 223 U.S.P.Q. 1264, 1271 (Fed. Cir. 1984).

The Herb et al. reference does not disclose all of the claimed elements. The Herb et al. reference fails to disclose an article comprising diamond deposited on a non-metallic framework material substrate having a porosity sufficient to permit the flow of

fluids in at least one direction through the material, at least as claimed in amended Claim

1. The Herb et al. reference discloses a non-porous material. There are no voids for fluid to flow. The Herb et al. reference repeatedly discloses that the material is formed from particles and after the particles are combined, the voids between are substantially completely filled with diamond. In fact, the article disclosed in the Herb et al. reference is inherently impermeable by a fluid and cannot permit the flow of fluids. The article of the Herb et al. reference also discloses that the mode of heat transfer through the material is by conduction not by convection of a fluid through the material. Thus, there would be no need for voids and voids would not be desirable for conductive heat transfer.

Additionally, in order to support an anticipation rejection based on inherency, an Examiner must provide factual and technical grounds establishing that the inherent feature necessarily flows from the teachings of the prior art. *Ex parte Levy*, 17 U.S.P.Q.2d 1461, 1464 (Bd. Pat. App. & Int. 1990); *In re Oelrich*, 666 F.2d 578, 581, 212 U.S.P.Q. 323, 326 (C.C.P.A. 1981) (holding that inherency must flow as a necessary conclusion from the prior art, not simply a possible one). The Office Action has not provided factual and technical grounds establishing that the substrate framework is inherently sufficiently porous to permit flow of fluids in at least one direction as disclosed in the prior art of Herb et al. Evidence that the inherency asserted by the Examiner is

derived as a necessary conclusion from the prior art, and not simply a possible conclusion, is respectfully requested.

Since the prior art reference fails to disclose each and every claimed element, then the prior art reference fails to anticipate the claimed invention. In view of the foregoing, it is respectfully requested that the rejection be withdrawn and it is respectfully asserted that the claims are now in condition for allowance.

Claims 1-5 stand rejected under 35 U.S.C. § 102 as being allegedly anticipated by Saito et al. (U.S. Patent No.6,361,857B1). This rejection is respectfully traversed.

In the Office Action at paper number 5, paragraph 7, the Office Action asserts that Saito discloses a heat sink comprising a thin diamond film formed on a porous substrate (Column 6, lines 24-32). The Office Action asserts that since the porosity of the porous body is at least 15% by volume and not more than 60% by volume (column 6, lines 59-60), the substrate is inherently expected to have porosity sufficient to permit the flow of fluids in at least one direction through the material. The Office Action asserts that Saito shows that an intermediate SiC layer 32 is disposed between the diamond film layer 31 and a porous substrate 26. The Office Action asserts that Saito discloses the diamond having a thickness of 24 microns (column 10, line 66) as well as a diamond film layer

having uniform thickness (column 8, line 37). Applicants respectfully disagree with the assertions in the Office Action.

The Saito et al. reference actually discloses a heatsink that includes a substrate of sintered compact forming a body having holes filled with copper and a thin diamond film layer formed on the substrate. (See Saito et al. at column 6, lines 25-32 and 55-63). The Saito et al. reference discloses that the diamond film of the heatsink permeates (fills and seals) the holes at the surface of the heatsink and that copper is melted into and fills the holes that are present in the porous body of the heatsink. (See Saito et al. at column 20, lines 50-67 and column 21, lines 1-2 and 25-40 and FIG.20 numerals 310 porous body, 311 holes, 312 copper and 320 diamond film). The Saito et al. reference discloses a heatsink that utilizes conductive heat transfer to cool semiconductors. The Saito et al. reference is silent as to convective heat transfer using a cooling fluid flowing through the heatsink.

The Saito et al. reference fails to disclose each and every claimed element. The Saito et al. reference fails to disclose an article comprising diamond deposited on a non-metallic framework material substrate having a porosity sufficient to permit the flow of fluids in at least one direction through the material, at least as claimed in amended Claim 1. The Saito et al. reference discloses a completely contrasting heat sink constructed for conductive heat transfer such that the structure is solid wherein the top surface is sealed

by a layer of diamond having no pores and the porous body is infiltrated with copper filling the holes to make a solid structure. The Saito et al. reference discloses a heat sink that has diamond surface on a metal substrate that has good adherence to the diamond and similar thermal expansion to diamond to avoid warping in the heat sink.

Additionally, in order to support an anticipation rejection based on inherency, an Examiner must provide factual and technical grounds establishing that the inherent feature necessarily flows from the teachings of the prior art. *Ex parte Levy*, 17 U.S.P.Q.2d 1461, 1464 (Bd. Pat. App. & Int. 1990); *In re Oelrich*, 666 F.2d 578, 581, 212 U.S.P.Q. 323, 326 (C.C.P.A. 1981) (holding that inherency must flow as a necessary conclusion from the prior art, not simply a possible one). The Office Action has not provided factual and technical grounds establishing that the substrate framework is inherently sufficiently porous to permit flow of fluids in at least one direction as disclosed in the prior art of Saito et al. Evidence that the inherency asserted by the Examiner is derived as a necessary conclusion from the prior art, and not simply a possible conclusion, is respectfully requested.

Since the prior art reference fails to disclose each and every claimed element, then the prior art reference fails to anticipate the claimed invention. In view of the foregoing, it is respectfully requested that the rejection be withdrawn and it is respectfully asserted that the claims are now in condition for allowance.

Claims 1, 2, 6, and 7 stand rejected under 35 U.S.C. § 102 as being allegedly anticipated by Ozmat (U.S. Patent No.6,196,307 B1). This rejection is respectfully traversed.

In the Office Action at paper number 5, paragraph 8, the Office Action asserts that Ozmat discloses a heat exchanger comprising a metallic foam being deposited with CVD diamond (column 4, lines 25-27). The Office Action asserts that the metallic foam is a network of ligaments which form numerous open cells (column 3, lines 5-7). The Office Action asserts that the porosity of the foam is sufficient to permit continuous flow of fluid coolant and that the metal foam is copper and silver (column 4, lines 16-18 and 25). Applicants disagree that the Ozmat reference anticipates the claimed invention as amended.

The Ozmat reference discloses a metal foam heat exchanger for direct bonding to an electronic module. The metal foam is a network of metal ligaments made of aluminum, copper, or silver. The metal ligaments are aligned in a direction substantially parallel to the direction of the heat flowing from the electronic module. The metal ligaments form a network of numerous open cells aligned in the same direction as the ligaments. The metallic foam can be deposited with CVD diamond. (See Ozmat at column 3, lines 5-20 and column 4, lines 23-26)

However, the Ozmat reference fails to disclose an article comprising diamond deposited on a non-metallic framework material substrate having a porosity sufficient to permit the flow of fluids in at least one direction through the material, at least as claimed in amended Claim 1. The Ozmat reference fails to disclose each and every claimed element. In contrast, the Ozmat reference discloses a metal foam with a metal structure made of a network of metal ligaments or metal wires which form numerous open cells. The metal ligaments provide a higher metal density to provide a lower thermal resistance in the direction of the heat flow.

Since the prior art reference fails to disclose each and every claimed element, then the prior art reference fails to anticipate the claimed invention. In view of the foregoing, it is respectfully requested that the rejection be withdrawn and it is respectfully asserted that the claims are now in condition for allowance.

The 35 U.S.C. § 103 Rejection

Claims 3-5 and 8-10 stand rejected under 35 U.S.C. § 103 as being allegedly unpatentable over Ozmat (U.S. Patent No.6,196,307 B1) in view of Saito et al. (U.S. Patent No.6,361,857B1) or Herb et al. (U.S. Patent No.5,316,842). This rejection is respectfully traversed.

In the Office Action at paper number 5, paragraph 10, the Office Action admits that Ozmat does not disclose an intermediate layer between the substrate and diamond film. The Office Action asserts that Figure 17 of Saito et al. shows that an intermediate SiC layer 32 is disposed between the diamond film layer 31 and a porous substrate 26. The Office Action asserts that Herb discloses the substrate being coated with a layer of a second material (column 7, lines 65-68). The Office Action asserts that it would have been obvious to have included an intermediate layer between the substrate and the diamond layer motivated by the desire to improve the adherence between the substrate and the diamond layer. Regarding Claims 4 and 9, the Office Action admits that Ozmat is silent as to a thickness of the diamond and surface roughness of the diamond. The Office Action asserts that Saito teaches the diamond having thickness of 24 microns (column 10, line 66). The Office Action asserts that Herb discloses the diamond having a thickness of 25 microns (column 10, line 10). The Office Action asserts that it would have been obvious to have altered the thickness range of the diamond layer since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art, citing *In re Aller*, 105 USPQ 233. The Office Action asserts that it would have been obvious to have optimized the thickness range of the diamond layer motivated by the desire to economize the cost of production and increase the adherence between the diamond layer

and the substrate with the warping reduced. Regarding Claim 5 and 10, the Office Action asserts that since the heat exchanger of Ozmat as modified by Saito or Herb is made of the same material and structurally the same as the presently claimed article, the coalescence of the diamond film would have been inherently present in the heat exchanger of Ozmat as modified by Saito. Regarding Claim 11, the Office Action asserts that since Ozmat discloses a heat exchanger with foam having between 5 to 100 voids per inch (claim 29), it would have been obvious to alter the void distribution of the foam based on an optimizing the ranges argument. The Office Action asserts that the motivation to alter the void distribution by the desire to control the degree of porosity of the foam. Applicants respectfully disagree with the assertions in the Office Action.

For an obviousness rejection to be proper, the Examiner must meet the burden of establishing that all elements of the invention are disclosed in the prior art; that the prior art relied upon, coupled with knowledge generally available in the art at the time of the invention, must contain some suggestion or incentive that would have motivated the skilled artisan to modify a reference or combined references; and that the proposed modification of the prior art must have had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was made. *In re Fine*, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988); *In Re Wilson*, 165 U.S.P.Q.

494, 496 (C.C.P.A. 1970); *Amgen v. Chugai Pharmaceuticals Co.*, 927 U.S.P.Q.2d, 1016, 1023 (Fed. Cir. 1996).

The combination of the Ozmat reference with either the Saito et al. reference, or the Herb et al. reference, fails to teach or suggest each and every claimed element. The combination of the prior art does not teach or suggest an article comprising diamond deposited on a non-metallic framework material substrate having a porosity sufficient to permit the flow of fluids in at least one direction through the material, at least as claimed in amended Claim 1. All of the prior art references teach a metal substrate or structure. Additionally the Saito et al. and the Herb et al. references teach a solid structure with the pores or holes in the structure filled with material, in, that fluid will not flow in at least one direction through the material. The Saito et al. and the Herb et al. references teach a heatsink that utilizes conductive heat transfer, and not convective heat transfer and therefore, would not even suggest the flow of a cooling fluid through the structure.

Additionally, the Office Action has relied upon optimization of ranges as a basis for rejection. Only result-effective variables can be optimized. A particular parameter first must be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 195 USPQ 6 (CCPA 1977). There has been no determination in the Office Action that the thickness of

the diamond layer or the void distribution is a result-effective variable as taught in the prior art references. Thus, reliance on the obviousness rejection based upon result-effective variables is not sufficient without evidence from the prior art. It is respectfully requested that evidence be provided, cited from the prior art references to prove that the diamond layer thickness or the voids in the foam are result-effective variables or the rejection must be withdrawn.

Further, the Office Action asserts that the coalescence of the diamond film would have been inherently present in the heat exchanger of Ozmat as modified by Saito et al. However, the Office Action has not provided factual and technical grounds establishing that the coalescence of diamond film is inherently necessary as disclosed in the prior art of the Ozmat and Saito et al. or Herb et al references. Evidence that the inherency asserted by the Examiner is derived as a necessary conclusion from the prior art, and not simply a possible conclusion, is respectfully requested.

Still further, there is no motivation to combine the prior art reference of Ozmat with Saito et al. or Herb et al. The Ozmat reference teaches away from the Saito et al. and the Herb et al. references. A factor cutting against a finding of motivation to combine or modify the prior art is when the prior art teaches away from the claimed combination. A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the

reference, or would be led in a direction divergent from the path that the applicant took.

See *In re Gurley*, 31 USPQ 2d 1130 (Fed. Cir. 1994).

The Ozmat reference teaches a heat exchanger that utilizes a cooling fluid flowing through an open foam cell structure formed by metal wire ligaments. The Ozmat reference relies on having open cells to allow cooling fluid to flow through the heat exchanger to perform cooling through convective heat transfer.

In contrast, both the Saito et al. and the Herb et al. references teach heatsinks that fill the pores and holes in the metal structure in order to enhance conductive heat transfer. The Saito et al. and Herb et al. devices having solid conductive heatsinks are not appropriate for convective heat transfer using a cooling fluid flowing through an open cell structure. As one of ordinary skill in the art understands, convective heat transfer flowing cooling fluid through a heat exchanger is much different than conductive heat transfer through a solid heatsink. One of ordinary skill in the art would be discouraged from combining the prior art reference of Ozmat with the prior art references of Saito et al. or Herb et al.

Since there is no motivation to combine the prior art references, then there is no *prima facie* case of obviousness.

In view of the foregoing, it is respectfully asserted that the claims are now in condition for allowance.

Dependent Claims

The argument and evidence set forth above is equally applicable here. Since the independent Claims 1 and 6 are allowable, then the dependent Claims 2-5 and 7-11 must also be allowable. If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q. 2d 1596 (Fed. Cir. 1988).

In view of the foregoing, it is respectfully requested that the rejection be withdrawn and it is respectfully asserted that the claims are now in condition for allowance.

Request for Allowance


It is believed that this Amendment places the above-identified patent application into condition for allowance. Early favorable consideration of this Amendment is earnestly solicited.

If, in the opinion of the Examiner, an interview would expedite the prosecution of this application, the Examiner is invited to call the undersigned attorney at the number indicated below.

Dated: October 28, 2002

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The following paragraphs provide the “As Amended” changes in a Marked-up format.

IN THE SPECIFICATION

Marked-up

The second paragraph at page 3.

The present invention is diamond foam, and means for its manufacture, consisting of diamond deposited on a pre-existing framework, said framework being compatible with diamond deposition, and having an open-cell structure adequate to permit fluid flow in at least one direction (axis) through the material subsequent to diamond deposition, said framework having structural integrity prior to the deposition of diamond. In particular, the framework does not consist of loose particles or fibers consolidated by diamond deposition.

IN THE CLAIMS

Marked-up

1. (Amended) An article comprising diamond deposited on a non-metallic framework material substrate having a porosity sufficient to permit the flow of fluids in at least one direction through the material.

6. (Amended) An article comprising diamond deposited on a non-metallic open-cell foam substrate having a porosity sufficient to permit the flow of fluids in at least one direction through the material.